SECRET
(When Filled In)

# R&D CONTROL FORM

19 March 1965

| 1. PROJECT TITLE/CODE NAME | 2. SHORT PROJECT DESCRIPTION |
|---|---|
| Reader Engineering | Production engineering of the [redacted] Variable-Width Film Reader. 25X1A |
| | 25X1A |

| 5. CLASS OF CONTRACTOR | 6. TYPE OF CONTRACT |
|---|---|
| Manufacturer | Fixed Price |

| 7. FUNDS | 8. REQUISITION NO. | 9. BUDGET PROJECT NO. |
|---|---|---|
| FY 19 $ 25X1A | N/A | NP-V-7 |
| FY 1965 $ [redacted] | 10. EFFECTIVE CONTRACT DATE (Begin - end) | 11. SECURITY CLASS. |
| FY 19 $ | July 1965-February 1966 | AA - Confidential<br>T - Unclassified<br>W - Unclassified |

12. RESPONSIBLE DIRECTORATE/OFFICE/PROJECT OFFICER TELEPHONE EXTENSION

25X1 DDI/NPIC/P&DS [redacted] 25X1A

13. REQUIREMENT/AUTHORITY

The NPIC is required to scan large volumes of film for the intelligence content. It is the purpose of this development to produce a machine, superior to those presently available, which can accomplish this task.

14. TYPE OF WORK TO BE DONE

Engineering Development

15. CATEGORIES OF EFFORT

| MAJOR CATEGORY | SUB-CATEGORIES |
|---|---|
| Viewers and Other Interpretation Equipment | Photo Measurement<br>Photo Interpretation<br>Optical Systems |

16. END ITEM OR SERVICES FROM THIS CONTRACT/IMPROVEMENT OVER CURRENT SYSTEM, EQUIPMENT, ETC.

Engineering design study for a production model Reader which is based upon the prototype Film Reader and which can be produced in quantity: it will incorporate an additional 3x magnification and other changes indicated by the prototype's evaluation.

17. SUPPORTING OR RELATED CONTRACTS (Agency & Other)/COORDINATION

This program is a follow-on to [redacted] and is being coordinated with other reader and viewer development programs. 25X1

18. DESCRIPTION OF INTELLIGENCE REQUIREMENT AND DETAILED TECHNICAL DESCRIPTION OF PROJECT (Continue on additional page if required)

The NPIC has contracted for and received delivery on a Film Reader prototype designed for on-line use. This reader will enable the photo interpreter to scan large volumes of film with increased effectiveness and will provide a measurement capability tied directly into the NPIC central computer for real-time data processing. The reader incorporates a light source of higher intensity than ever before used in equipment of this type; consequently, a liquid film gate will be used to adequately cool the film, protecting it from heat damage.

19. APPROVED BY AND DATE

| OFFICE | DEPUTY DIRECTOR | DDCI |
|---|---|---|
| | | |

FORM 11-64 2338 SECRET GROUP 1 (1-13)

R & D Catalog Form continued...

18. In addition, the equipment is capable of higher accuracy measurements than previous film readers of this type.

Although the prototype reader has been successfully completed, an extensive engineering redesign is now needed too for the purpose of improvements indicated in the course of the prototype evaluation. The redesign is also directed toward reducing the cost, complexity, and overall size of potential production models. Features to be included in the proposed redesign are:

1. The cabinet and frame will be changed to insure the required structural rigidity and to reduce the overall size. The approximate dimensions of the new structure are: 6-feet high, 3-feet wide, and 7-feet long, excluding control panel. In addition, removable extensions are required on each side to allow for rotation of the film transport increasing the total width to 4-feet.

2. An additional magnification of 3x will be provided giving five available magnification ranges of 3x, 6x, 12x, 24x, and 48x.

3. The film gate size will be increased to $9\frac{1}{2}$-inches square to allow projection of a full $9\frac{1}{2}$-inch width format at 3x.

4. A variable-width reel mechanism will be incorporated to accept any film size from 70mm to $9\frac{1}{2}$" without adapters and to maintain the center of the film on the same line with respect to the center of the film platen regardless of the film width used. The center of rotation will lie on the center of the film as long as the lateral stage is at center.

5. The film loading system will be redesigned to insure simplicity of loading with a minimum of operator effort. In the event that all the leader is pulled through the platen, it will be possible to rethread the machine without disassembling the platen or other components.

6. All specifications or features now available on the prototype reader will be maintained or improved upon.

All necessary security procedures are in effect at the contractor's
25X1 plant as a result of previous [redacted] contracts. There will be no deliverable hardware as a result of this contract, but complete specifications and drawings for production bids will be delivered. The same on-line accumulator system as used in the prototype will be employed in the production model.

SECRET

#5015

24 November 1964

MEMORANDUM FOR: Chief, Information Processing Division, NPIC

THROUGH : Assistant for Plans and Development

SUBJECT : Request for Assistance in Selecting a Small Special Purpose Computer

25X1A

1. The Plans and Development Staff is planning to contract for a Rear Projection Film Reader with a built in computer before the end of the fiscal year. The reader would be similar in concept to the [redacted] units now under development but with a built-in computer instead of the Univac 490 interface presently in use.

2. The objective of this development is to give the Photo Interpreter a comparator/computation capability, independent of the central processing site, so that, in the event of a central site failure a back-up capability will be available. In addition, the reader will be available for setting up a satellite operation when required.

3. It is requested that the IPD System Branch assist P&DS in selecting a small special purpose computer for the reader or outline specifications for selecting the computer. The computer selected must have the capability of handling inputs from all the present and projected new camera systems to allow the PI to perform any single frame computations he may require.

4. To allow sufficient time for the contracting of the reader within this fiscal year it is necessary that the above requested information be furnished by 30 December 1964.

25X1A

[redacted]

Development Branch, P&DS

Distribution: Orig. + 1 - Addressee
1 - project file
1 - chrono

25X1A

25X1 NPIC/P&DS/DB [redacted] (24 Nov. 1964)

SECRET

SECRET
(When Filled In)

TECHNICAL BACKGROUND PROCUREMENT INFORMATION

25X1A

I. [redacted]

B. Evaluation of previous performance: Satisfactory

II. Brief description of this procurement: Film Reader Engineering as a follow-on to the development of the prototype.

25X1A

Estimated total amt. [redacted]

A. Deliverable items: Complete specification and drawings for procurement action for production units.

B. Is this procurement for other than a standard, "off the shelf" or slightly modified commercial item? Yes If "yes", is it anticipated that any more of this unit will be procured? Yes If so, a complete set of directly reproducible manufacturing drawings and specifications would normally be included in this procurement. Comments:

C. Will contract cover a period of more than 90 days? Yes If "yes", are progress reports desired? Yes If so, indicate frequency, content and number of copies desired: Monthly, to include a summary of work performed during the reporting period, % of work complete, financial report, and % of funds expended and committed.

D. Is any Government-owned property to be provided to the contractor?

No If so, list and indicate its availability (where, when, etc.)

SECRET
(When Filled In)

SECRET
(When Filled In)

E. Is any special tooling involved? No

F. Security:

1. Association with the Sponsor is Confidential

2. The specifications and/or drawings are Unclassified

3. The item is Unclassified

4. Contractor personnel known to be aware of this proposed procurement:

25X1A

5. Other security information

III. Reasons for selection of this source. If other sources were considered, indicate results. If no other sources were considered, list the reasons why this firm is considered to be uniquely qualified to perform this work.

25X1A

[redacted] has successfully built a prototype film reader demonstrating feasibility, however, a number of changes and improvements are required before additional production units can be considered. There is no other company with the experience to do the production engineering without going through the prototype stage.

IV. If contract will cover deliverable item(s) state room location where equipment will be installed N/A. (It is extremely important that the Engineering Data Sheet including room location and any other pertinent facts be submitted to NPIC Engineering Section as far as possible in advance of delivery.)

25X1A

V. Technical contact [redacted] Date 17 Mar 65 Telephone 2476

In the event additional space is required, use the reverse side(s) of this form, with a reference to the item number to which the comment applies.

SECRET
(When Filled In)

Answer to Ed's Comments.

Page 3. No fine focus is required for the 3X and 6X magnifications, since the field of focus of these lenses exceeds the maximum allowable film motion within the ~~fit~~ platten in an operational mode.

Page 4 The engineers have designed the production model with five less lenses, as shown on the drawings, in the illumination system; therefore allowing them to reduce the lamp requirements to 2500 KW as opposed to the present 5000 KW lamp. At the same time the overall heat in the system is reduced to allow a smaller freon cooling system to be used. This complies with operations request for a cooler more compact piece of equipment.



The present system, 165, has never been

operated with the lamp power turned all the way up (to my knowledge). Personally it hurts my eyes to do it even on fairly dense material. Since the operational people have never given us their comments ~~it was decided that~~ we designed to what we felt was proper. Their evaluation may reveal a different opinion (if we get it).

Page 9

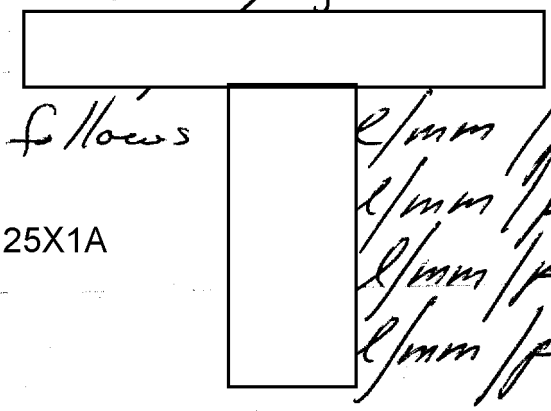
The best piece of equipment in house the "[redacted] Interchangable Rhomboid Stereoscope", is only capable of resolving [redacted] 25X1A

We can hardly expect to get much more than [redacted] 25X1A on a screen. What's the difference if this is screen limited or lens limited. What counts is the overall system resolution. At any rate this is only an engineering estimate we can't be expected to put absolute numbers on an unbuilt lens system. There is no reason to believe [redacted] 25X1A

will not meet the same standards as they now have on the 165. It is our job to see that they maintain their standards. If they do build this equipment we will have our sine wave test equipment by that time and will be able to check their resolution very closely as they are building their system.

Ed wants to know what is the resolution at each magnification? We don't know absolutely, we can only calculate:

25X1A



at 48X

therefore it follows

l/mm power at 24X
l/mm power at 12X
l/mm power at 6X
l/mm power at 3X

25X1A

Ed says the Old Delft screen is highly directional - he should indicate this in his evaluation of the 165 - We should ask him what effect this characteristic has on the PI.

Pag 10 The least count and accuracy is the same as on the 165.

Pag 12 I told Ed we would require 25X1A [redacted] to propose on a fully automatic loading system. How we get it is our problem - not his.

Page 13 This condition must exist with a liquid platten however it is much more accessible than the 165 configuration. as the drawings show.

# SECTION I

# SYSTEM DESCRIPTION AND SPECIFICATIONS #265

## 1.1 INTRODUCTION

25X1A

The [redacted] Variable Width Film Reader #265 is a precision measuring instrument designed to illuminate and project high density film and to measure points on that film to a least count of 10 microns. A special feature of the Reader is the use of liquid Freon to cool the intensely illuminated film.

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 Frame

The system components are mounted on a welded steel frame braced to eliminate sway and vibration. The front section of the Reader is enclosed by a sheet aluminum shell which supports the viewing screen and the control panel. Access panels on either side of the console support most of the electronic components of the assembly.

The frame is mounted on four casters for easy movement. Three leveling jacks may be lowered to level the system components when the Reader is positioned. These should be used for leveling the optical platform base only, and should not in any circumstances be used to lift the casters clear from the floor.

### 1.2.2 Lamp

The film is illuminated by a 2500 watt Xenon lamp mounted in a steel housing at the front of the console. A lamp power supply unit mounted in

a separate cabinet provides power to the lamp through a starter unit on the right of the console. Cables from the starter terminate at the top of the lamp to start the lamp and supply operating power.

The lamp is cooled by water brought in through a solenoid valve mounted on the frame at the water inlet. The solenoid is switched on automatically when the machine is switched on. The water is exhausted through a fitting on the lamphouse.

The lamp is also air cooled. The air is drawn into the lamphouse at the bottom through a filter. The top of the lamp being connected to the customer's vacuum supply.

1.2.3 Condenser Lenses and Cold Mirror

Light from the lamp passes through several condenser lenses which concentrate the light and direct it to the film platen area. A cold mirror reflects the light upward through the platen and film to the projection lenses mounted above. The mirror is mounted on a heat sink which removes the heat transmitted through the mirror, thus reducing heating of the optical elements and film.

The condenser lenses mounted in the lower and linear condensing lens turrets are switched in and out of the optical path by air cylinders actuated by the MAGNIFICATION pushbuttons on the control panel. The various lens combinations adjust the light convergence angle to maximally illuminate the format magnified by the different projection lenses.

1.2.4 Projection Lenses, Projection Mirror and Screen

Five projection lenses magnify the film image 3X, 6X, 12X, 24X and 48X. The

lenses are carried on sliding platforms moved by air cylinders which are activated by the MAGNIFICATION pushbuttons. Each lens is carried on a separate platform and in the case of the 12X, 24X and 48X lens, these are provided with a fine focus mechanism remotely operated by a switch on the control panel. Not necessary to focus 3X & 6X lenses?

The projection mirror is a first surface mirror which reflects the image to the rear-projection screen.

1.2.5 Film Transport

The reel of film to be viewed is mounted in the low-pressure housing, and driven across the film platen by a capstan motor, two reel drive motors, or a transmitter-receiver pair.

The capstan motor drives a capstan roller to move the film slowly across the platen for film scanning purposes. The motor may be actuated by the JOYSTICK CONTROL or by the SCAN lever on the control panel. The film movement produced by the capstan rotation deflects dancer arms which actuate the reel drive motors to maintain film tension. The film speeds available in the scan mode are indicated in Table 1-2 of this manual. The capstan roller may also be driven by means of a transmitter-receiver pair actuated by the X-AXIS handwheel on the control panel. This allows manual positioning of the film for measuring purposes.

The two printed circuit reel motors drive the reels at high speeds for rapid film slew and rewind. The motors are actuated by the SLEW lever on the control panel. See para. 1.3.8 for film speeds in this mode.

When most of the film has been driven onto one of the reels, end-of-film sensing arms in the film housings actuate level-sensitive mercury switches which turn on the END OF FILM indicator light at the front of the console. An air blower assembly dries the film as it is reeled back onto the supply spool.

1.2.6 Freon Circuit

The level in the reel housing is sensed by a photo-electric level control. This control governs the speed of the Freon pump so that the Freon level is maintained at an approximately constant level. Should there be too little Freon in the circuit, a warning "ADD FREON" indicator will light up and the film drive servos will be stopped, preventing any film travel.

The pressure in the high pressure housing is maintained at about 3 psi by a pressure regulator assembly. A pressure regulator valve maintains the pressure in the tank at the desired level. Should the pressure rise about 1-2 psi, a relief valve opens to bleed some of the air to the atmosphere. A pressure gage indicates the pressure level in the housing.

The pressure in the high pressure housing forces the Freon from the housing through the liquid film gate assembly. As the Freon flows on either side of the film suspended between the two platens, it removes heat, cooling the intensely illuminated film. The Freon then passes into the low pressure housing where it is drained into the Freon tank where it is cooled by a water cooler.

1.2.7 Lateral Drive

The film transport stage rests on air bearings above the rotating table. A leadscrew is mounted on the underside of the stage, perpendicular to the film motion axis. A motor actuated by one axis of the JOYSTICK CONTROL rotates the leadscrew through a pulley drive, causing the screw to travel along a ball nut bolted to the granite table. The travel of the stage perpendicular to the film motion axis produced a lateral (across the film) image motion on the viewing screen and allows the operator to bring any portion of the film frame to the center of the screen.

Four air bearings on the film transport stage move along a guide way bolted to the table to maintain linearity of stage travel. A pressure-sensitive switch between the air intake manifold and bearings opens the power circuit to the film and stage servos should the air pressure fail.

1.2.8 Rotational Drive

The rotating table above which the film transport air bearings travel is supported on a large diameter ball bearing bolted to the chassis frame. An integral gear is mounted on the outside diameter of the bearing. A. P.C. motor actuated by the ROTATION knob on the control panel drives the ring gear through a reduction gear train to rotate the stage on the bearing. This rotates the image on the screen to aid in operator orientation.

Limit switches interrupt the circuit when the stage has traveled 181° in either direction from center. The table may be automatically returned to the rotational center position by pressing the FILM LOAD switch on the control

panel. This actuates the rotational drive motor to drive the table the shortest distance to the rotational center position. Microswitches provide direction-sensing logics. A microswitch interrupts the circuit at the rotational center position.

1.2.9 Data Logics

A metering capstan is mounted at one side of the liquid film gate housing. An optisyn encoder is mounted at one end of this capstan. As the film is driven between the two reels, the encoder records the metering capstan rotations to provide a record of film travel along the X axis. The data is relayed to counters at the front of the console and displayed on nixie tubes on the control panel. Another Optisyn encoder is mounted on the lateral drive leadscrew to record stage travel along the Y axis. This information is also relayed to the counters at the front of the console and displayed on the nixie tubes.

Measurements on the film can thus be made by successively bringing two different points on an image to the reticle pattern in the viewing screen. The difference in the counter readings between the two points is the distance between the points in X and Y coordinates.

1.2.10 Reticle

A reticle projector is mounted behind the projection mirror and projects a reticle approximately two inches across onto the screen. The brightness of the reticle may be altered by the RETICLE CONTROL on the left of the control panel.

## 1.3 SPECIFICATIONS

### 1.3.1 Construction and Frame

Frame: Fabricated from 6 x 4 x 1/2 steel angle. Inside painted dull, non-reflecting black. Bracing eliminates sway and vibration. Four casters are bolted to the frame for ease of movement. Three leveling jacks may be lowered when the Reader is positioned. See para. 1.2.1.

Shell: Sheet aluminum. Access panels on either side and under the Console facilitate service and maintenance.

### 1.3.2 Dimensions and Weight

Dimensions: Length - 96 inches. Width - 42 inches. Height - 78 inches on casters. NOTE: Width required for operation is 60 inches.

Weight: Approximately 2000 pounds.

1.3.3 Requirements

Line Voltage and Frequency: 208V, 3-phase, wye-connected, 60 cycle AC supplied through grounding plug and flexible covered cable. Variations in supply frequency of ± 5 cycles and ± 10 volts are acceptable, with resultant variations in motor speeds and lamp life.

Water Pressure: 30 psig for lamp cooling circuit. Water outlet required.

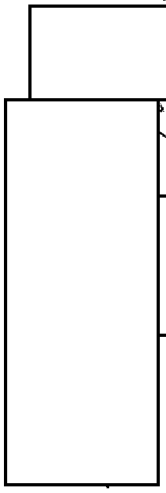
Air Pressure: 90 psig for air bearings. 5 psi for high pressure housing. Air exhaust for lamphouse and film drying assembly required.

1.3.4 Operating Environment

Temperature: 58-95°F.

Relative Humidity: 40-60%.

ILLEGIB Barometric Pressure: 27.00-30.00 in. Hg.



1.3.5 Illumination Optics

Lamp: Xenon arc lamp, 2500 Kw, 80 amps maximum at approximately 32 volts. Illuminance of 100 foot-lamberts at the screen with film density of 1.0. Expected life of 500-1000 hours at rated load.

Lamp Power Supply: Christie Type CX-6500, 3-phase, 60 cycle, 208/240V, 25 amps. Arc voltage of 30 volts, arc current of 140 amps.

Lamp Starter: Christie Type 1G-25A, 100V, 60 cycle, 160 amps maximum.

Cold Mirror: First surface mirror, flat to within 1 fringe/inch using yellow line of helium.

ILLEGIB

ILLEGIB

## 1.3.6 Projection Optics

Table 1-1. Optical Switching

| Projection Lenses | 3X | 6X | 12X | 24X | 48X |
|---|---|---|---|---|---|
| Linear Condensers | — | 3 | 3 | 3 & 4 | 3 & 4 |
| Zoom Condensers | 5 & 6 | 5 & 6 | 5 & 6 | 5 & 6 | 5 & 6 |

25X1A

25X1A

Projection Lenses: Four [redacted] Resolution

[redacted]

Fine Focus: Projection lenses vertical travel as required on 12X, 24X, 48X.

Projection Mirror: First surface mirror flat to within 2 fringes/inch using yellow line of helium.

25X1A

Viewing Screen: 30 inch x 30 inch Old Delft rear-projection screen or Polacoat. Center of screen 48 inches from floor.

## 1.3.7 Film Format Accepted

Number of Reels: One takeup and one supply reel.

Size: 70mm, 5 inch, 6.6 inch, 8.0 inch and 9-1/2 inch wide; 500 to 1000 feet long; 0.0025 to 0.0007 inches thick; maximum reel diameter of 10.5 inches.

Type: Negative or diapositive film.

## 1.3.8 Film Drive

Drive Motors: Two DC printed circuit torque motors. One DC printed circuit capstan motor. One synchro transmitter-receiver pair.

Film Tension: Two tension-sensing dancer rollers.

Film Speeds: Slew speed - over 200 ft/minute. Scan speed - see table below.

Table 1-2. Film Speed in Scan Mode

| Magnification | Joystick Range | Median Speed |
|---|---|---|
| 48X | 0.02"-0.08"/sec. | 0.05"/sec. |
| 24X | 0.05-0.20"/sec. | 0.10"/sec. |
| 12X | 0.10-0.40"/sec. | 0.20"/sec. |
| 6X | 0.20-0.80"/sec. | 0.40"/sec. |
| 3X | | |

1.3.9 Lateral Drive

Drive Motor: Servo motor.

Stage Travel: ± 5 inches from center.

Stage Speed: 0.05" - 2"/sec.

Air Bearings: 4 air bearings lift film transport less than .001 inches above granite guideways.

1.3.10 Rotational Drive

Drive Motor: 488 PC motor with integral gear reduction.

Stage Rotation: 362 Total.

Stage Speed: Approximately 60 seconds from one limit to the other.

1.3.11 Measurement and Data Electronics

X-Axis: Optisyn encoder on capstan provides 4096 counts. Quadrupling electronics produce 16,384 counts/revolution.

Need count per ? Accuracy ?

Y-Axis: Optisyn encoder on leadscrew provides 127 counts. Doubling electronics produce 254 counts/revolution.

1.3.12 Auxiliary Equipment

Freon Tank: Capacity of 5 gallons.

## 2.2 LOADING THE FILM

The film is loaded in the low pressure side of the film transport assembly. Before loading the film, see that the film load switch on the control panel is depressed thus indicating "LOAD" on the pushbutton. The low pressure side may be ascertained readily because it has the Optisyn encoder on the box side, and has the smaller Freon tank underneath it. It also has a connection on top for the 2 1/2" vacuum hose.

1) Disconnect the vacuum hose, if the air dryer has been used, and close the vacuum valve.

2) Release the latches securing the box lid and open it all the way until it rests against the stops provided for it.

3) Place the loading tray on the top of the upturned cover.

4) Pull the reel holder assembly out of the box so that it rests on the loading tray.

5) Place the reel of film on the loading tray so that it is lined up with the

reel spindles and the loose end of the film is on top of the reel pointing into the machine.

6) Pull out the knob of the reel spindle adjustment handle and wind the spindles into the reel center.

7) Release the knob and wind the handle slowly back until it locks into place.

8) Rotate the "wrap around roller" yoke about the capstan roller, until it latches into position.

9) Fasten the film end to the film leader using 3M #853 pressure sensitive tape. Place one layer of tape on each side. Do not overlap two layers of film or tape because this may make the film too thick to pass through the gate.

10) Gently move the reel holder back into the transport box. The wrap around roller will automatically release, taking up the slack film.

11) Close and latch the box cover.

12) Open the high pressure box cover and check that all the slack film has been taken up.

13) Close and latch the cover securely into place.

14) Adjust the Freon baffles so that they just clear the edge of the film. Each side is adjusted independently by turning the knob at the right hand edge

of the platen. There is a clamping thumbscrew beside the knob which locks the baffle when it has been adjusted.

15) The "ADD FREON" indicator will light up a few moments after the load switch is depressed. It should extinguish a few moments after a magnification button is depressed after the loading is completed.

NOTE: In the case of film breakage, the leader on the film may be reloaded by carrying out steps (1) thru (8) as per the loading instructions and proceeding as follows: (9) Push the film on leader between the capstan roller and wrap around roller whence it will be fed automatically through the film gate, and will reappear between the wrap around roller and capstan roller on the opposite box. Should the film stick in the gate, the top platen may easily be removed by unscrewing the clamping screws which hold it in place, inserting two of the screws in the lifting holes provided in the platen holding frame and lifting the platen out. The film may then be assisted in its travel through the gate and out into the transport box.

ILLEGIB

2.3 LAMP TURN-ON

1. Check to see that the main power cord on the top of the console is plugged into a 208 volt, 60 cycle AC outlet. Also check to see that: the control cable and power supply cable on the right side of the console are plugged in. The film load switch on the console panel should be in the LOAD position.

2. Turn the main breaker switch on the Reader left side ON. The LOW FREON light and NIXIE tubes at the front of the console should come on immediately. The film load light on the panel will glow.

3. Depress the film load switch. The film load light will go off, air will be supplied to the film transport air bearings, power will be applied to the film drive servos, and Freon will be pumped into the high pressure tank.

4. Wait until the LOW FREON light on the front panel goes out. It should take approximately one minute to fill the tank.

NOTE: The LOW FREON light should be on only when the film load switch is in the LOAD position, or for the one minute period just after the film load switch is depressed. If the LOW FREON light comes on at any other time, turn the BRIGHTNESS knob on the control panel to dim the lamp to the least bright position.

Check the Freon pumping system immediately and add Freon to the upstream box as required.

5. Check to see that the BRIGHTNESS knob on the control panel is in the START position. This will ensure that the lamp will start, and will also prevent overheating.

6. Place the toggle switch on the lamp power supply in the ON position. The fan in the power supply will turn on, and a reading of approximately

70 volts should appear on the voltage meter.

7. Turn the lamp start switch on the control panel.

8. The lamp current indicator on the front panel should read approximately 15 amps at the lowest setting of the BRIGHTNESS control. Adjust the setting to the lamp brightness desired.

NOTE: When the BRIGHTNESS control is turned up, a temporary drop in the meter reading and in the image brightness will occur. Wait a few moments until the lamp is receiving the current set by the knob.

9. The Freon boils at 117°F., producing wavering and bubbling on the screen. Turn the lamp brightness down when this occurs.

10. The lamp current indicator should never read more than 80 amps. If it does read 80 amps or more, turn the lamp down immediately to avoid burning the film.

11. The "NO VACUUM" warning light will begin to glow if the lamp vacuum supply fails. If the light comes on check vacuum connection.

12. If the "NO WATER" warning light glows, check the water supply to the instrument.

## 2.4 ADJUSTING MAGNIFICATION AND FOCUS

For the initial viewing, the 3X magnification will probably be used. If the indicator lamp in the 3X MAGNIFICATION pushbutton is not lit, depress the pushbutton to switch the proper projection and condenser lenses into the optical path.

The focus may be adjusted by means of the FINE FOCUS toggle switch on the control panel for 12X, 24X and 48X only. The switch actuates a small motor which moves these projection lenses vertically to focus the image.

## 2.5 ADVANCING THE FILM

### 2.5.1 Using the FILM MOTION CONTROL (Joystick)

For viewing purposes, a scanning film speed is normally used. Deflect the JOYSTICK CONTROL (hereafter referred to as the joystick) to the right to drive the film from the supply to the takeup reel. The projection lenses invert the image to produce a left-to-right image motion on the screen.

Deflect the joystick to the left to drive the image from right to left, i.e. to drive the film from the takeup to the supply reel.

The joystick is spring-loaded and must be manually held off center to drive the film. The joystick is also interlocked with the other film drive controls so that they remain inoperative if accidentally actuated while the joystick is being operated.

The joystick may be deflected along the Y axis to drive the film transport stage laterally to the film motion axis (see para. 2.6. below).

2.5.2 Using the SCAN Lever

The SCAN lever is used primarily to move the film slowly across the platen for careful inspection of the image and for measuring purposes. Deflect the SCAN lever to the right or left to move the image slowly across the screen. The SCAN lever is not spring-return and will remain at the position to which it is set until manually returned to the center position.

The film will move at speeds from .02 inches to .80 inches per second in the scan mode. The SLEW and JOYSTICK 'X' motion controls are inoperative when the SCAN lever is actuated.

2.5.3 Using the X AXIS Handwheel

The X AXIS handwheel may be used to manually bring a point on the image into coincidence with the reticle on the screen. Rotate the handwheel clockwise to move the image right; counter-clockwise to move the image left.

2.5.4 Using the SLEW lever

The film may be driven at speeds over 200' a minute for rapid film advance and rewind. Deflect the SLEW lever to the right or left to drive the film across the platen at high speeds. The SLEW lever is spring-return and must be held off center manually for slewing purposes.

2.6 USING THE LATERAL DRIVE CONTROLS

A whole film frame cannot be seen on the screen at the higher magnifications. To travel across the image from one side of the frame to the other, deflect the

JOYSTICK along the Y axis---the axis perpendicular to the film motion or X axis. A p.c. motor will move the film transport stage laterally to the film motion axis.

The stage may also be moved laterally by the Y AXIS handwheel. Rotate the handwheel clockwise to move the image "down"; counter-clockwise to move the image "up". The handwheel is interlocked with the Y-axis of the JOYSTICK.

The image may be moved diagonally across the screen by:

1. deflecting the joystick into one of the quadrants formed by the two axes, or by
2. deflecting the joystick along the Y axis while the SCAN or SLEW levers are actuated.

## 2.7 ROTATING THE IMAGE

The film transport assembly is mounted on a table which may be rotated to rotate the image on the screen. Turn the ROTATION knob on the control panel clockwise to rotate the stage clockwise; counterclockwise to rotate it counter-clockwise. The STAGE AZIMUTH INDICATOR on the control panel will indicate the stage position in $1^{o}$ increments to the operator.

## 2.8 UNLOADING THE FILM

The END OF FILM warning light under the screen will glow when most of the film is reeled onto one or other of the reels. The reel that is empty is on the same side of the machine as the indicator light, (assuming the stage is not rotated by more than $\pm$ 90°.)

To unload the film:

1) Deflect the SLEW lever to the left until the end of film light glows.

ILLEGIB

2) Watch the screen until the takeup reel leader appears. Then return the slew lever to the center position.

3) Depress the film LOAD switch, located in the top right hand corner of the control panel, to the LOAD position (the light is on). If the switch is not in the load position, power will continue to be supplied to the reel motors, making it impossible to remove the film spool.

   The LOW FREON light should come on soon after depressing the LOAD switch.

4) Unlatch the low pressure film housing cover and open it all the way until it rests against the stops provided for it.

5) Place the loading tray on the top of the upturned cover.

6) Pull the reel holder assembly out of the box so that it rests on the loading tray.

7) Rotate the "wrap around roller" yoke counter-clockwise about the capstan roller, until it latches into position.

8) Remove the tape securing the film to the leader. Tape the leader to the box edge.

9) Pull out the knob of the reel spindle adjustment handle and open out the reel spindle. Firmly grasp the reel whilst doing this.

10) Remove the reel and reel loading tray from the machine.

11) Move the reel holder assembly gently back into the box.

12) Close and latch the box cover.

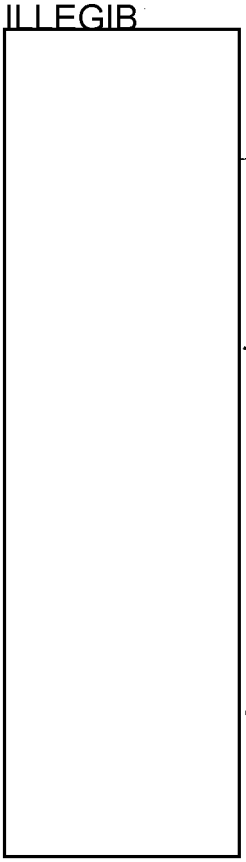
2.9 TURN OFF

1) Turn the BRIGHTNESS knob to the Least Bright Position.

2) Turn the main breaker switch off.

## 2.10 CHANGING AND ADJUSTING THE LAMP

ILLEGIB



1. Rotate Film Transport to loading position and move to maximum Y travel away from the screen.

2. Switch off Main Power Supply.

3. Remove electronics racks at left side of machine.

4. Remove panel in front of the operator's knees.

5. Remove the vacuum hose connection at the top of the lamphouse.

6. Loosen the cold mirror clamp at the back of the lamphouse and pull the mirror holder out by about 2". Note the position mark on the mirror holder.

7. Remove the filter from the bottom of the lamphouse.

8. Remove the cable from each end of the lamp. Unscrew only the top nut at the top end of the lamp.

9. At the base of the lamphouse loosen the small hex locknut closest to the lamp.

10. Tap the cable terminal gently upwards to loosen the collet holding the lamp itself.

11. At the top of the lamphouse grasp the large hex nut and terminal, and turn counter-clockwise and lift simultaneously.

12. Gently lift the lamp clear of the lamphouse.

13. Unloosen the lamp from the top collet by unscrewing the lower nut on the terminal and tapping the terminal gently.

14. Exchange lamps (of the same type), clamping the new lamp into the top collet by tightening the lowest nut of the terminal. Do not overtighten.

15. Lower the lamp and collet assembly back into the lamp house making sure the lower terminal engages in the bottom collet.

16. Free the lamp from the top collet so that it falls into the correct location on the bottom collet.

17. Tighten the lower collet.

18. Turn the top collet assembly clockwise.

19. Tighten the top collet by tightening the lowest hex nut.

20. Move the cold mirror at the back of the lamphouse back to its original position. (The scribed mark level with the clamp).

21. Refasten electrical cables and vacuum hose.

22. Replace Panels and Racks.

Note: The lamp can be changed as indicated in the foregoing without altering any of the original adjustments, except that of the cold mirror.

## 2.11 LAMP ADJUSTMENT

a) Arc Height

1. Loosen the bottom collet as in (9) and (10) in the previous instruction.

2. Loosen the large hex nut at the bottom of the lamphouse.

3. Adjust the height of arc by turning the adjuster which is locked by the large hex nut.

4. Lock the adjuster with the large hex nut.

5. Retighten collet and attach cable to it.

b) Arc Horizontal Position

1. Remove the vacuum attachment from the top of the lamp.

2. Loosen the two inner fillister head screws at the top of the lamphouse.

3. Loosen the top collet.

4. Loosen bottom collet.

5. Move the top of the lamp horizontally into the required position.

6. Hold this position and tighten the two fillister head screws.

7. Tighten bottom collet.

8. Tighten top collet.

9. Reconnect vacuum hose.